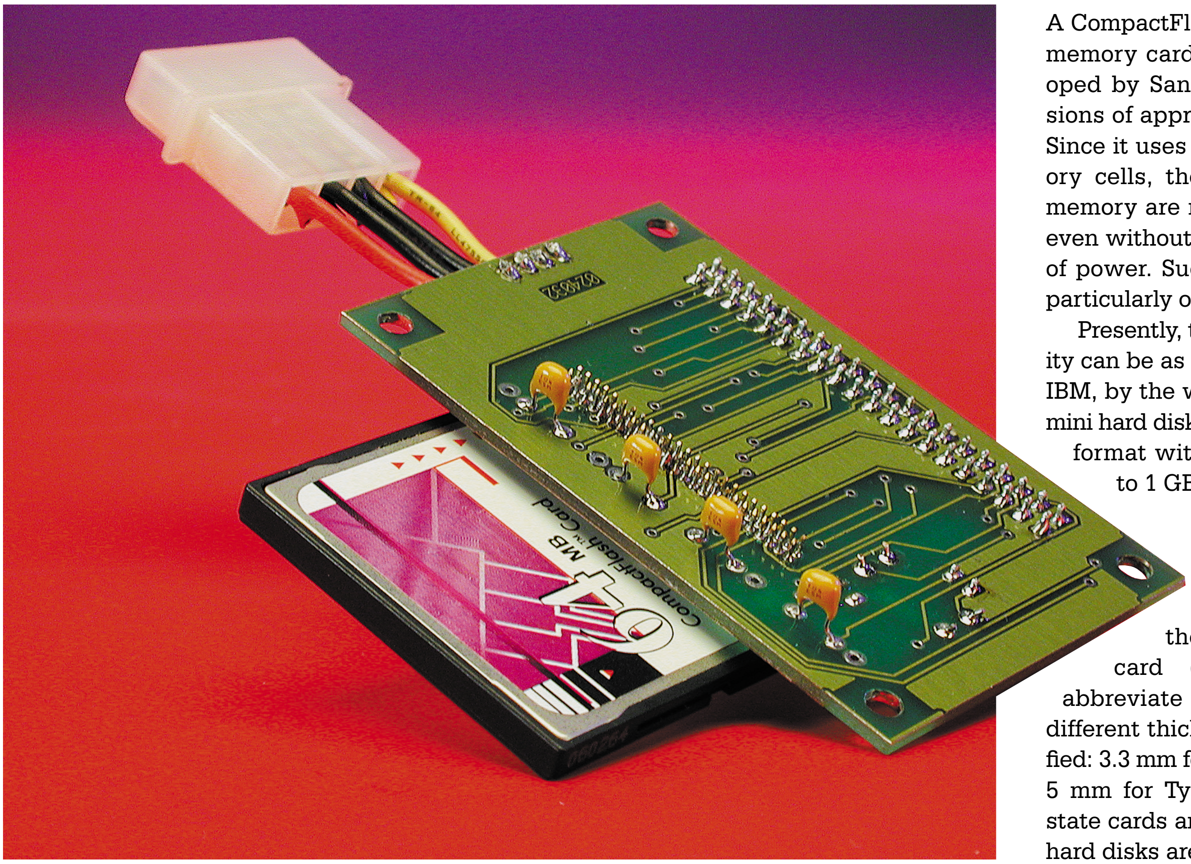
CompactFlash Drive on IDE Bus

solid-state memory for the PC

Design by Paul Goossens

CompactFlash cards are memory media that retain their contents without a supply voltage. They are used in digital cameras, among other things. Thanks to the 'intelligence' present in such a card, it can also be easily connected to a PC, for example for use as a 'solid-state drive'. The super-simple adapter described here makes it easy to connect all types of CompactFlash cards to a PC.



A CompactFlash card is a small memory card, originally developed by Sandisk, with dimensions of approximately 4×4 cm. Since it uses non-volatile memory cells, the contents of the memory are retained for years, even without a separate source of power. Such cards are used particularly often in Digicams.

Presently, the memory capacity can be as much as 1 GBytes. IBM, by the way, even supplies mini hard disks in CompactFlash format with capacities of up to 1 GBytes.

Figure 1 shows the dimensions and pin designations of the CompactFlash card (which we will abbreviate to 'CF card'). Two different thicknesses are specified: 3.3 mm for Type I cards and 5 mm for Type II. Most solid-state cards are Type I, while CF hard disks are Type II.

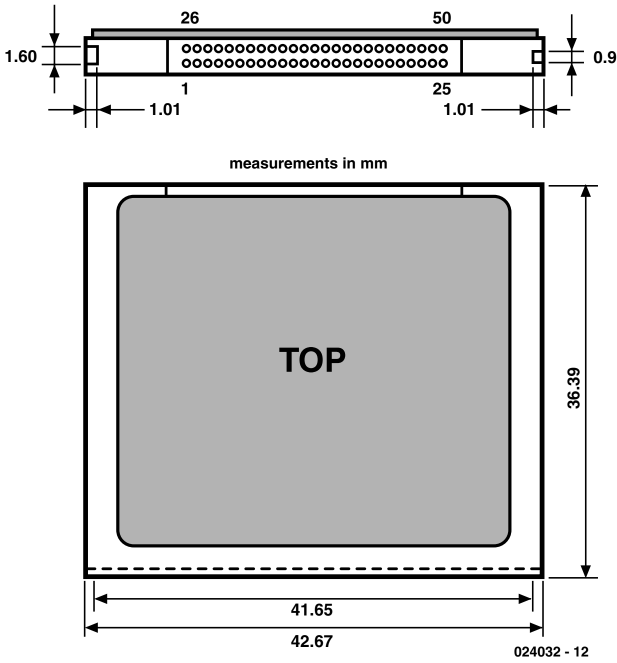


Figure 1. CompactFlash card dimensions and pin designations.

Figure 1: Pin designations

Function	Pin	Pin	Function
GND	1	26	$\overline{\text{CD1}}$
D03	2	27	D11
D04	3	28	D12
D05	4	29	D13
D06	5	30	D14
D07	6	31	D15
$\overline{\text{CE1}}$; $\overline{\text{CE1}}$; $\overline{\text{CS0}}$	7	32	$\overline{\text{CE2}}$; $\overline{\text{CE2}}$; $\overline{\text{CS1}}$
A10	8	33	$\overline{\text{VS1}}$
$\overline{\text{OE}}$	9	34	$\overline{\text{IORD}}$
A09	10	35	$\overline{\text{IOWR}}$
A08	11	36	$\overline{\text{WE}}$
A07	12	37	$\overline{\text{RDY}}$; BSY; $\overline{\text{IREQ}}$; INTRQ
VCC	13	38	VCC
A06	14	39	$\overline{\text{CSEL}}$
A05	15	40	$\overline{\text{VS2}}$
A04	16	41	RESET; RESET; $\overline{\text{RESET}}$
A03	17	42	$\overline{\text{WAIT}}$; $\overline{\text{WAIT}}$; $\overline{\text{IORDY}}$
A02	18	43	$\overline{\text{INPACK}}$
A01	19	44	$\overline{\text{REG}}$
A00	20	45	BVD2; $\overline{\text{SPKR}}$; DSAP
D00	21	46	BVD1; $\overline{\text{STSCHG}}$; $\overline{\text{PDIAG}}$
D01	22	47	D08

Notes:
$\overline{\text{XX}}$ = inverted signal
For pins with three designations (aa; bb; cc):
aa: in Memory mode
bb: in I/O mode
cc: in True IDE mode

The prices of CF cards have dropped sharply in the last year, so you can presently buy a card with a capacity of 64 MBytes for less than £ 60.

Internally, a CF card consists of a number of memory modules driven by a their own controller. Data input and output take place in parallel, just as with a hard disk. Thanks to this 'intelligent' design, such a card can easily work together with a microcontroller system or PC.

PCMCIA adapters are available to allow CF cards to be used with notebooks. These are actually nothing more than extenders for the connection bus.

There is a wide variety of commercially available card readers, fitted with USB, serial-port or parallel-port connectors, to allow CF cards to be used with PCs.

Given the affordable prices and non-volatile memory characteristics of CF cards, it is unquestionably interesting to use such a card as an extra storage medium for the PC, for instance as a replacement for the floppy-disk drive. For this, you do not even have to buy a separate reader, since the circuit described in this article provides a much simpler solution.

Passive circuit

The intelligence present in the card allows it to be used in three different modes. One of these is the 'true IDE mode', which is obtained by connecting pin 9 to ground. In this mode, the external behaviour of the card is the same as that of a hard disk drive with an IDE interface. The only other thing we need is a sort of adapter with two connectors to allow the CF card to be connected to the IDE bus of the PC.

The schematic diagram of this adapter circuit is shown in **Figure 2**. It primarily consists of two connectors, augmented by some passive components. K1 is the connector for the IDE bus, while K2 provides the connection to the CF card.

The remaining components can be quickly described. LED D1 makes the read and write activities of the CF card visible, with R1 determining how much current flows through the LED. Pin 39 of the CF connector is connected to +5 V via resistor R2. This makes the CF card act as a 'master' on the IDE bus. If pin 39 is connected to ground by means of jumper JP1, the CF card will act as a 'slave' on the bus. The two capacitors C1 and C2 decouple the supply voltage.

There is yet another connector (K3) on the circuit board; it is used to connect the supply voltage. In spite of the fact that the CF card needs only +5 V and ground, a four-way connector has been chosen here in order to remain compatible with the supply connectors inside the PC. The 12-V pins of these connectors are thus not used.

Construction

The double-sided printed circuit board shown in **Figure 3** is quite handy for building the circuit. Although all that we have here is two connectors and a few auxiliary components, the 50-pin CF connector is a bit difficult. The pin pitch of a normal connector is 0.1 inch, but with a CF connector it is only 0.05 inch (slightly more than 1 mm). It is thus practically impossible to link the two connectors together using loose lengths of wire. Even with the printed circuit board, it is essential to work carefully and use a fine soldering iron tip.

If your enthusiasm has been aroused and you want to build this circuit, we would like to give you some good advice: first see whether you can obtain the CF connector! It is available from Farnell, among others, but most electronic components shops won't have such a connector in stock. Once you have the connector, you can buy the circuit board and the rest of the components.

The connectors, the resistors and the LED are all fitted to the top side of the board. The two decoupling capacitors are fitted to the bottom side, which means that you must cut their leads short on the top side so they won't touch the CF card.

For the power supply connector, take an extension cable or splitter for the PC power supply (a standard item that can be bought in any PC shop) and cut off the plug. Then solder the wires attached to the (male) mating connector to the K3 position. The red wire is +5 V, the two black wires are ground and the yellow wire is +12 V.

After all of this is done, you can fit JP1 as needed to have the CF card be seen by the PC as a slave drive (if there is already a hard disk or CD-ROM drive on the IDE bus in question and it is configured as the master). Without the jumper, the card is automatically the master.

Following this, the adapter board can be fitted into the PC and connected. One option is to make a slot in a blank 5.25-inch front panel and

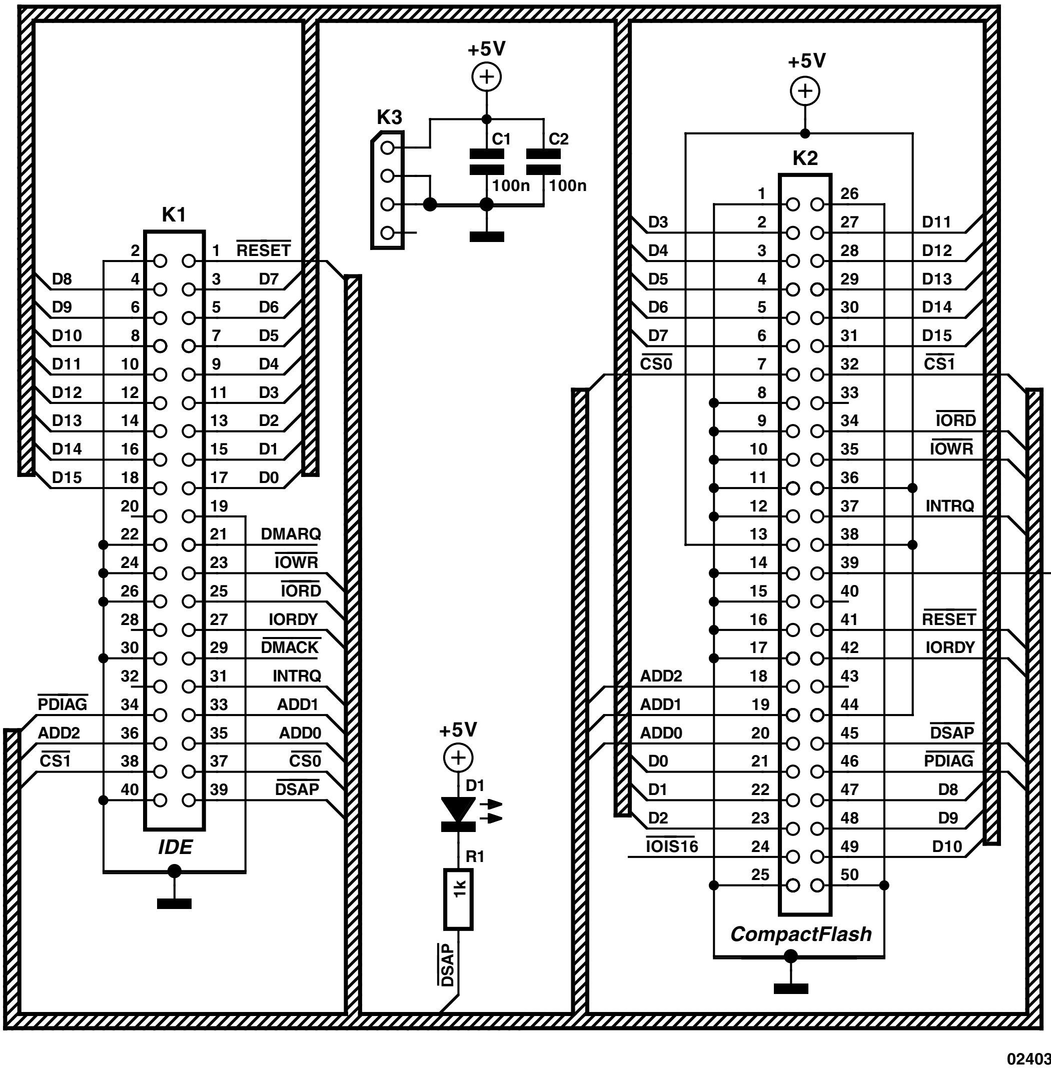
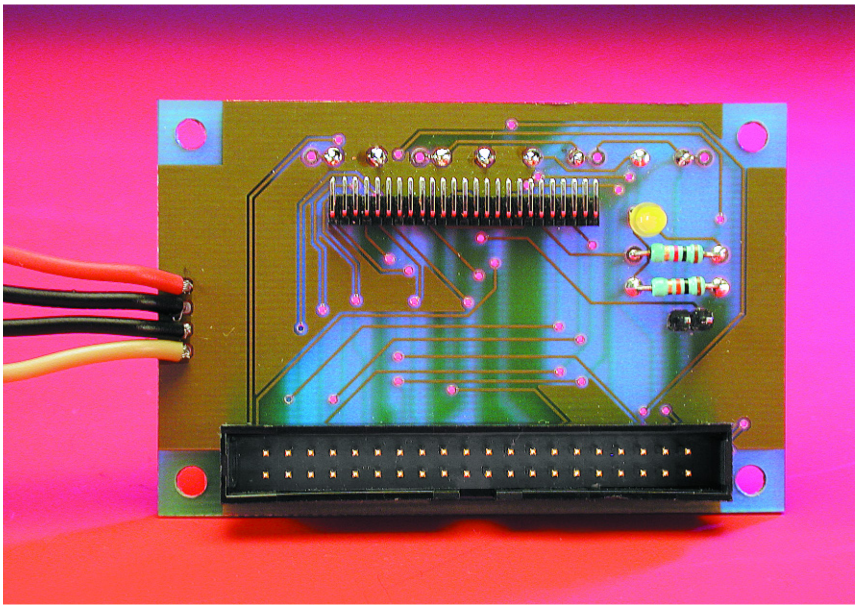


Figure 2. Schematic diagram of the adapter: no active components.



fit the card on the back of the panel, **upside down**. K2 must be located just behind the opening. The circuit board can be connected to one of the IDE busses on the motherboard using K1 and a standard IDE cable. Connect the mating connector attached to K3 to one of the PC's free power supply plugs.

Now everything is ready for use. To be on the safe side, we recommend that you insert or remove the CF card only when the PC is off.

After you have connected a CF card for the first time and started up the computer, Windows will report that a driver for the new device is being installed. Normally, the driver will already be present and the rest of the procedure is automatic, but sometimes you may have to insert the Windows installation CD in the CD-ROM drive.

After the driver has been installed, Windows will automatically recognise the CF card as a sort of hard disk drive and you can read and write files in the usual manner.

In concluding this article, we wish to give you a **clear warning: always plug the CF card into the connector on the circuit board the right way around.** This means that **the top side of the CF card must face towards the circuit board**. This is also why the board is fitted in the computer with the components to the bottom. The photo at the beginning of the article clearly shows what we mean. If you want to play safe here, you can fit a small nib in the insertion slot for the CF card. As can be seen in Figure 1, the guide grooves on the two opposite edges of the CF card have different widths, and you can take advantage of this.

(024032-1)

COMPONENTS LIST

Resistors:
R1 = 1kΩ
R2 = 10kΩ

Capacitors:
C1,C2 = 100nF

Semiconductors:
D1 = LED, yellow, low current

Miscellaneous:
K1 = 40-way boxheader
K2 = 50-way pinheader, angled pins, 0.05"-grid (Farnell # 3078127)
JP1 = 2-way pinheader with jumper
Extension cable for PC supply
PCB, order code **024032-1** (see Readers Services page)

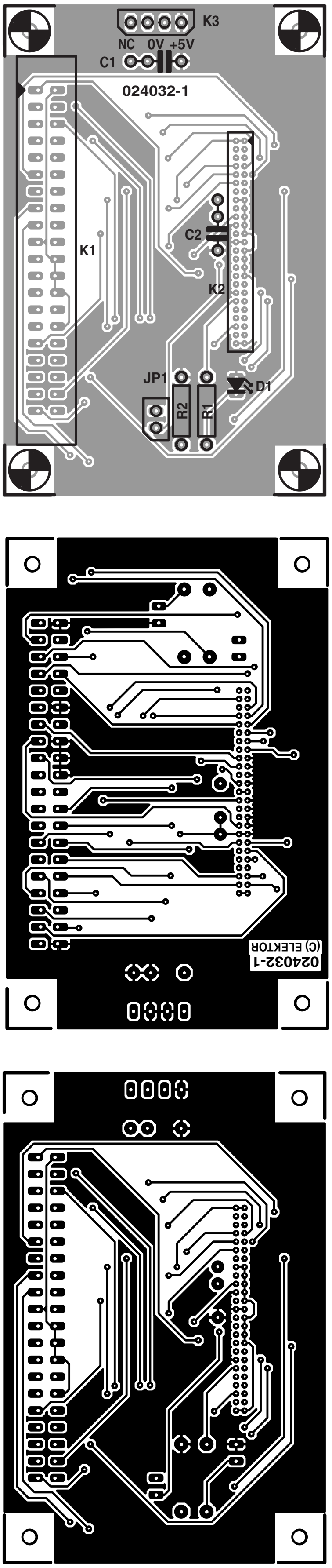


Figure 3. This double-sided printed circuit board makes it easier to build the circuit, especially as regards fitting K2.